OK to E-file
JKS 10/26/07

AMENDMENTS TO THE CLAIMS

The following listing of claims replaces all previous listings and versions of claim in this application.

1. (Currently Amended) A method for treating a semiconductor material for subsequent bonding which comprises bombarding a surface of the semiconductor material with a beam containing a controlled number of ions in ion clusters to etch a pattern in the surface with the beam, wherein the number of ions is controlled to provide a desired roughness of the surface pattern to improve adhesion during subsequent bonding; and bonding the surface of the semiconductor material to a surface of a semiconductor substrate to form a detachable substrate structure.

2. (Cancelled)

3. (Original) The method of claim 1, wherein the ions comprise chemically inert species in relation to the semiconductor material.

4. (Original) The method of claim 3, wherein the semiconductor material is made of at least one of silicon or silicon carbide, and the ions are argon ions or nitrogen ions.

5. (Original) The method of claim 1, wherein the surface is bombarded with ions that are capable of chemically reacting with the semiconductor material.

6. (Original) The method of claim 5, wherein the ions are generated from a plasma.

7. (Original) The method of claim 6, wherein the surface layer and the plasma are Si and SF_6, SiC and SF_6/O_2, SiO_2 and SF_6/O_2, SiO_2 and CHF_3/SF_6, Si_3N_4 and $CHF_3/O_2/SF_6$, respectively.

8. (Original) The method of claim 1, wherein the number of ion clusters bombarding the surface is controlled to smooth the surface to a roughness value suitable for molecular bonding.

9. (Original) The method of claim 8, which further comprises controlling the number of ions bombarding the surface by controlling the pressure of an ion source that generates the ion clusters.

10. (Original) The method of claim 1 which further comprises controlling an acceleration voltage that is applied to the beam to control the speed of the ion clusters and the resulting etching of the surface.

11. (Original) The method of claim 1 which further comprises directing the ion clusters to selectively treat desired zones of the surface to create an adjusted pattern thereon.

12. (Original) The method of claim 1 which further comprises focusing the beam such that the ions, any monomer species of the ions, and the ion clusters are directed towards a portion of the surface of the semiconductor material to cause etching thereof.

13. (Original) The method of claim 12 which further comprises directing the beam of ion clusters to a selected impact site on the surface of the semiconductor material.

14. (Original) The method of claim 13, wherein the semiconductor material is moved to provide the desired pattern.

15. (Currently Amended) ~~The method of claim 14~~ A method for treating a semiconductor material for subsequent bonding which comprises

bombarding a surface of the semiconductor material with a beam containing a controlled number of ions in ion clusters that is directed to is directed to a selected impact site on the surface of the semiconductor material to etch a pattern in the surface with the beam by moving the semiconductor material to provide the desired pattern, wherein the number of ions is controlled to provide a desired roughness of the surface pattern to improve adhesion during subsequent bonding, which further comprises creating an appropriate spatial pattern on the surface that has a different roughness in comparison to other portions of the surface.

16. (Original) The method of claim 15, wherein a plurality of patterns of variable roughness are created on the surface .

17. (Original) The method of claim 1, wherein the semiconductor material is one that is recycled after removal of a transfer layer.

18. (Currently Amended) ~~The method of claim 1,~~ A method for treating a semiconductor material for subsequent bonding which comprises bombarding a surface of the semiconductor material with a beam containing a controlled number of ions in ion clusters to etch a pattern in the surface with the beam, wherein the number of ions is controlled to provide a desired roughness of the surface pattern to improve adhesion during subsequent bonding; and further wherein the semiconductor material includes at least one layer of a material that is different than the semiconductor material, with the layer providing the surface of the semiconductor material that is etched by the bombarding.

19. (Original) The method of claim 18, wherein the semiconductor material includes at least two layers of materials that are different than the semiconductor material, with the outermost layer providing the surface of the semiconductor material that is etched by the bombarding.

20. (New) A method for treating a semiconductor material for subsequent bonding which comprises:

bombarding a surface of the semiconductor material with a beam containing a controlled number of ions in ion clusters to etch a pattern in the surface with the beam, wherein the number of ions is controlled to provide a desired roughness of the surface pattern to improve adhesion during subsequent bonding; and

controlling the number of ions bombarding the surface by controlling the pressure of an ion source that generates the ion clusters, or controlling an acceleration voltage that is applied to the beam to control the speed of the ion clusters and the resulting etching of the surface.